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Abstract: This report is concerned only with the Iberian Peninsula. These data should provide the basic information needed in order to appreciate the dangers that threaten the pardel lynx and to assess the proposed conservation measures, including the past- and present-day distribution, changes in range over the years, size of population, threats to the survival of the lynx and proposals for conservation.

Status and conservation of the pardel lynx (Lynx pardina) in the Iberian peninsula

Report presented by ICONA
Servicio de Vida Sivestre, Spain

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CONTENTS

1. INTRODUCTION

Before examining the status of the pardel lynx at the present time, it is necessary to say a word about its classification. Some authors consider it to be a subspecies of the European lynx (Lynx lynx) or Felis lynx), while others regard it as a totally different species (Lynx pardina or Felis pardina). If we place it in the first category, then we are looking at a species that extends throughout the Palearctic region and - if we include the Canadian lynx, Lynx canadensis, in this category - the Holarctic also. This species is not seen as being threatened.

If we include it in the second category, we are up against what is probably the most threatened carnivore in Europe (Mallinson, 1978).

In either case, the pardel lynx constitutes a totally separate form for which conservation measures are clearly indispensable, irrespective of taxonomic considerations.

Authors who consider the pardel lynx as a subspecies of Lynx lynx include Ellerman and Morrison-Scott (1951) and Corbet (1978), in their reviews of the mammals of the Palearctic region. Among the advocates of the second hypothesis one finds Kurten (1968), van der Brink (1970, 1971) and Werdelin (1981). According to Kurten, the European lynx and the pardel lynx co-existed in Central Europe without cross-breeding during the Pleistocene period; van der Brink, on the other hand, considers that this co-existence continues today in the Pyrenees and the Carpathians, and probably in other regions. Werdelin (1981) concludes from his craniometric research that Lynx pardina became separated from the ancestral mainstream before the other present-day species of lynx, with the result that it is now further from the European lynx than from the North American species.

The hypothesis that attributes a specific identity to the pardel lynx was adopted by Honacki and others (1982) in their list of mammal species of the world and is the one we shall adopt in this report.

There is some controversy over whether the pardel lynx still exists in south-eastern Europe, as van der Brink (1970) states, or whether all the lynxes of that region are now classifiable as Lynx lynx; the second of these hypotheses is the more generally accepted (Vasilui and Decei, 1964; Atanasov, 1968; Kurten, 1968).

This report is concerned only with the Iberian Peninsula.

The data currently at our disposal describe the pardel lynx as an animal which has very definite habitat requirements and depends heavily on the rabbit (Oryctolagus cuniculus), for food. Studies on the subject consistently reveal the presence of rabbit in more than 80% of excrements analysed (Beltrán 1987). At present the pardel lynx is a species characteristic of Mediterranean Quercus, Pistacia, Arbutus and Olea forests and of Phyllirea, Cistus, Erica, Halimium, Ulex and Genista maquis.

This habitat combines two important features: areas of ample plant cover needed for daytime rest and reproduction, and areas which are more open; these are used as feeding sites by rabbits, and therefore attract the lynx as well (Beltrán, 1987).

In the Doñana National Park, the lynxes occupy between 1,000 and 2,500 hectares of living space; the male's territory is generally larger than that of the female (Beltrán and others, 1987). The females give birth once a year in March or April, usually to two young per litter (Delibes and others, 1987).

These data should provide the basic information needed in order to appreciate the dangers that threaten the pardel lynx and to assess the proposed conservation measures.

Although rare, the pardel lynx has been researched in depth, mainly by the team working under the direction of Dr Miguel Delibes, of the Estación Biológica de Doñana (Seville). In 1987, Beltrán published a select bibliography bringing together all the information available up to that time; and in 1988 an important research project was carried out to determine the status of the pardel lynx in Spain and the measures necessary for its conservation (Rodríguez and Delibes, 1988). Much of the information given later in this report is taken from these findings.

2. PAST DISTRIBUTION

Since the 19th century, the earliest period for which scientific records are available, the range of the lynx has receded considerably. Graells (1897) estimated that in the mid-19th century the species lived on virtually the whole of the Iberian Peninsula, although varying in abundance from one region to another.

That the distribution was as wide as this in the past has also been proved by the discovery of fossils and subfossils in numerous localities of the Iberian Peninsula (Alicante, Catalonia, Lisbon, south and south-eastern regions etc). By the early years of the 20th century, according to Cabrera (1914), the lynx had disappeared or was very rare in Northern Spain, although apparently still abundant in the central and southern regions.

After a period for which we have no information, several research workers began again in the 1960s and 1970s looking into the distribution and situation of the lynx in Spain (Valverde, 1963; Garzón, 1978; Delibes, 1979). The data presented by these authors are by and large consistent and agree with those obtained later by Rodríguez and Delibes (1988), despite some discrepancies due to differences of methodology and research intensity.

Thirty years ago, according to the later authors, the range of the lynx was limited to the south-western quarter of the peninsula (map 1, table 1), and covered a total area of 57,000 km^2, of which 82% was South of the Tagus. The inhabited area was contained between the Sierra Morena, the Toledo Mountains and the Eastern Extremadura (34,000 km^2) and extended over large regions of the Sierra de San Pedro, Doñana and the Sistema Central. Apart from this last zone, there was no discontinuity between the different population groups, all but a few of which formed a line stretching from east to west alongside the mountain ranges.

The presence of lynx in isolated, diminutive areas (Ancares Leoneses, Pyrenees, Tortosa and Beceite, south-eastern Albacete, Sierras Penibéticas), for which no confirmatin has been found in recent times seems to indicate that the species lived there during the final stage of its decline.

In Portugal, the lynx was present early in the century practically throughout the country. From the 1940s onwards, the application of the "wheat programme" started a rapid recession which was accentuated during the two subsequent decades by the outbreak of myxomatosis and the large-scale planting of pine and eucalyptus over much of the lynx's range.

3. PRESENT-DAY DISTRIBUTION

According to the inventory compiled by Rodríguez and Delibes (1988), the present zone of the pardel lynx in Spain covers some 14,000 km^2; this figure includes the 3,000 km^2 consisting of the 43 diminutive areas (none of which is greater than 350 km^2) where the authors were unable to confirm reports that the lynx was present, despite indirect evidence to that effect.

The remaining 11,000 km^2 (2% of the total area of Spain) are divided up into 48 zones in which the lynx is regularly present: these vary considerably in size, density and degree of isolation (map 2.A) and are located for the most part in the south-western quarter of the country; only eight of them seem to harbour more than 25 lynxes.

The most important feature of these areas is their smallness: 44% are under 100 km^2, and 91% less than 500 km^2. The four largest regions (No. 23, Sierra Morena; Nos. 32 and 34, Toledo Mountains; No. 39 in Eastern Extremadura - see map 2.A and table 2) account for more than half the territory inhabited by the lynx in Spain.

In Portugal, little is known about the distribution of the lynx. Its occurrence probably regular in the Serra da Malcata, in the Contenda-Barranco region (North East Baixo Alentejo) and in the Serras Algarvianas (Espinhaca de Cao, Monchique and Caldeirao) (Delibes, 1979; Palma, 1980). Residual nuclei where there have been sporadic sightings in recent years include: Bacia do Sado, North Eastern Tramontano, the Serra de Aire, Serra de Portil-Serra de Ossa, and the Tagus Valley between Portugal and Spain (see map 2.B).

4. CHANGES IN RANGE OVER THE YEARS

In Spain, the range of the lynx has declined considerably over the past 30 years, a phenomenon that should be seen in the light of the following considerations:

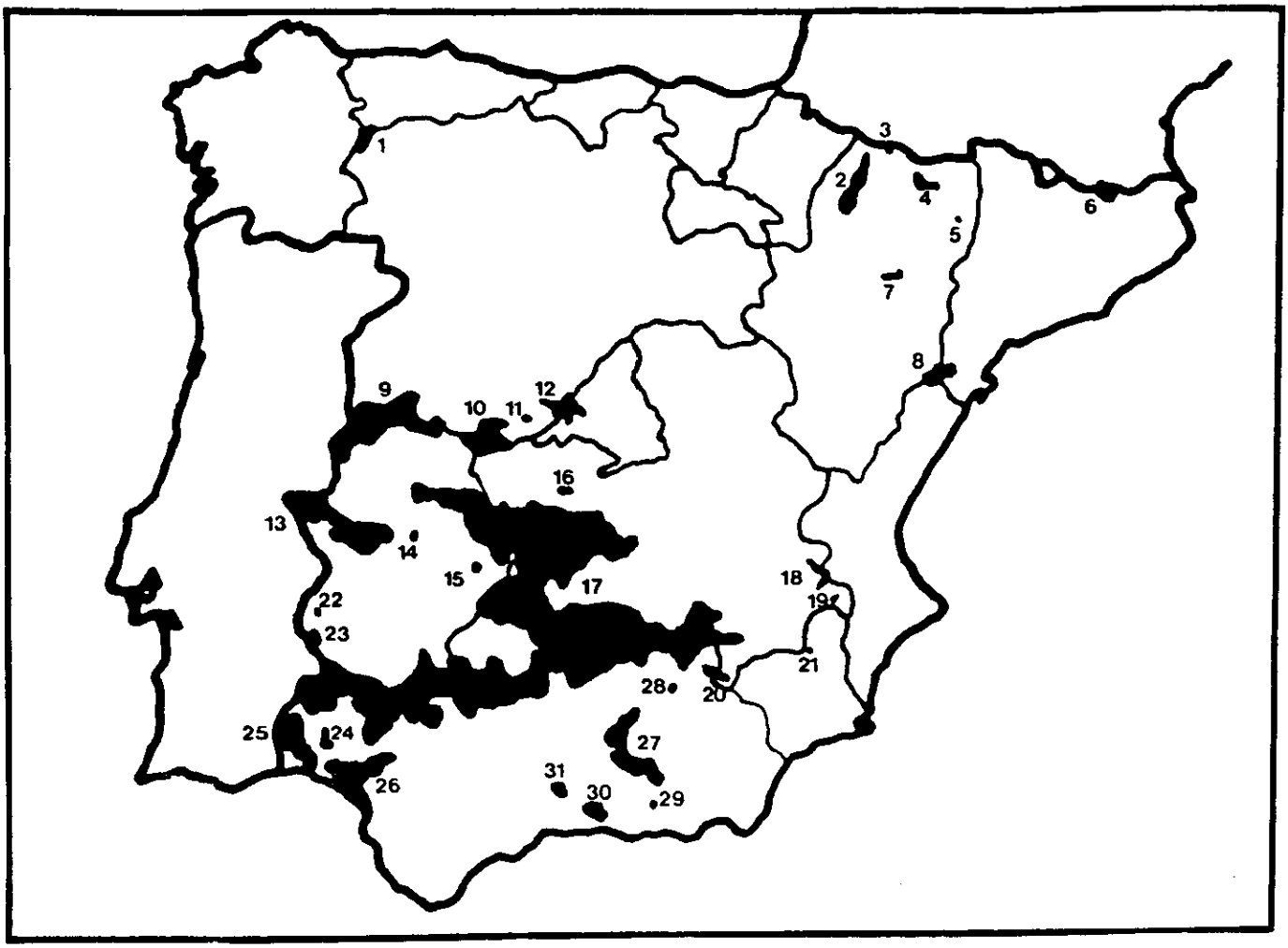
* the lynx inhabits only 81% of the territory it occupied in 1960;

* it survives in only eight of the 30 regions occupied in 1960;

* since that date, no recolonisation of formerly occupied areas has taken place, apart from a few small local increases in population density attributable to habitat protection measures or improvements in environmental conditions;

POPULATION		AREA (x 100 km^2)
1.	Ancares	2
2.	Pirineo oscense (Luesia) *	13
3.	" " (Alto Gállego) *	1
4.	" " (Ainsa) *	8
5.	" " (Benabarre) *	1
6.	Pirineo catalán (Ribas de Freser) *	4
7.	Sierra de Alcubierre *	4
8.	Puertos de Tortosa y Beceite *	5
9.	Gata, Lagunilla, Peña de Francia y Béjar	39
10.	Gredos (Candeleda)	17
11.	" (Casavieja) *	1
12.	Alto Alberche	9
13.	Sierra de San Pedro	35
14.	Sierra de Montánchez *	1
15.	Sierra de Pela *	1
16.	Castrejón *	3
17.	Sierra Morena, Montes de Toledo, Villuercas y Monfragüe	338
18.	Albacete (Almansa) *	7
19.	" (Fuente Alamo) *	2
20.	" (Nerpio) *	4
21.	Sierra del Puerto (Murcia) *	1
22.	Badajoz (Alconchel) *	1
23.	" (Oliva de la Frontera) *	3
24.	Sierra Morena de Huelva (Valverde del Camino) *	5
25.	Andévalo	15
26.	Doñana	23
27.	Sierra Nevada, Sierra Mágina y Sierra Harana	20
28.	Cazorla *	1
29.	Sierra de la Contraviesa *	1
30.	Tejeda y Almijara *	10
31.	Montes de Antequera *	3
	TOTAL	578

Table 1 (see figure)



Map and Table 1 (source: Rodríguez and Delibes, 1988)

Ranges of distribution of lynx in Spain: location and extent in 1960. The sign * indicates areas in which the authors were unable to detect any trace of the presence of lynx in recent times.

	Range Reg. Pr.	Density	Range Reg. + Occ. Pr.	Density	N
Doñana (8-12)	35128	0.7391	53870	0.5690	49
SM Huelva (1-7)	55145	0.4090	103695	0.2877	53
SM Sevilla (13)	12988	0.5800	25988	0.4150	17
SM Córdoba (14-19)	47970	0.6357	61970	0.5453	60
SM Oriental (20-28)	392832	0.7605	517282	0.6260	518
Subbéticas (29-31)	31692	0.4096	54392	0.3047	27
Montes de Toledo (32-38)	232136	0.5355	282136	0.4835	221
Extremadura Orient (39-40)	61212	0.4285	99712	0.3225	51
Sist Central Occ (41-44)	76162	0.4251	116662	0.3122	59
Gredos (45-46)	64160	0.3000			31
S San Pedro (47-48)	52600	0.4483	77600	0.3683	46
TOTAL	1062025	0.5874	1393307	0.4874	1132

Table 2 (source: Rodríguez and Delibes, 1988)

Ranges of distribution of the lynx in Spain at the present time: extent, population size and average density. Figures in brackets refer to the population nuclei shown on map 2.A.

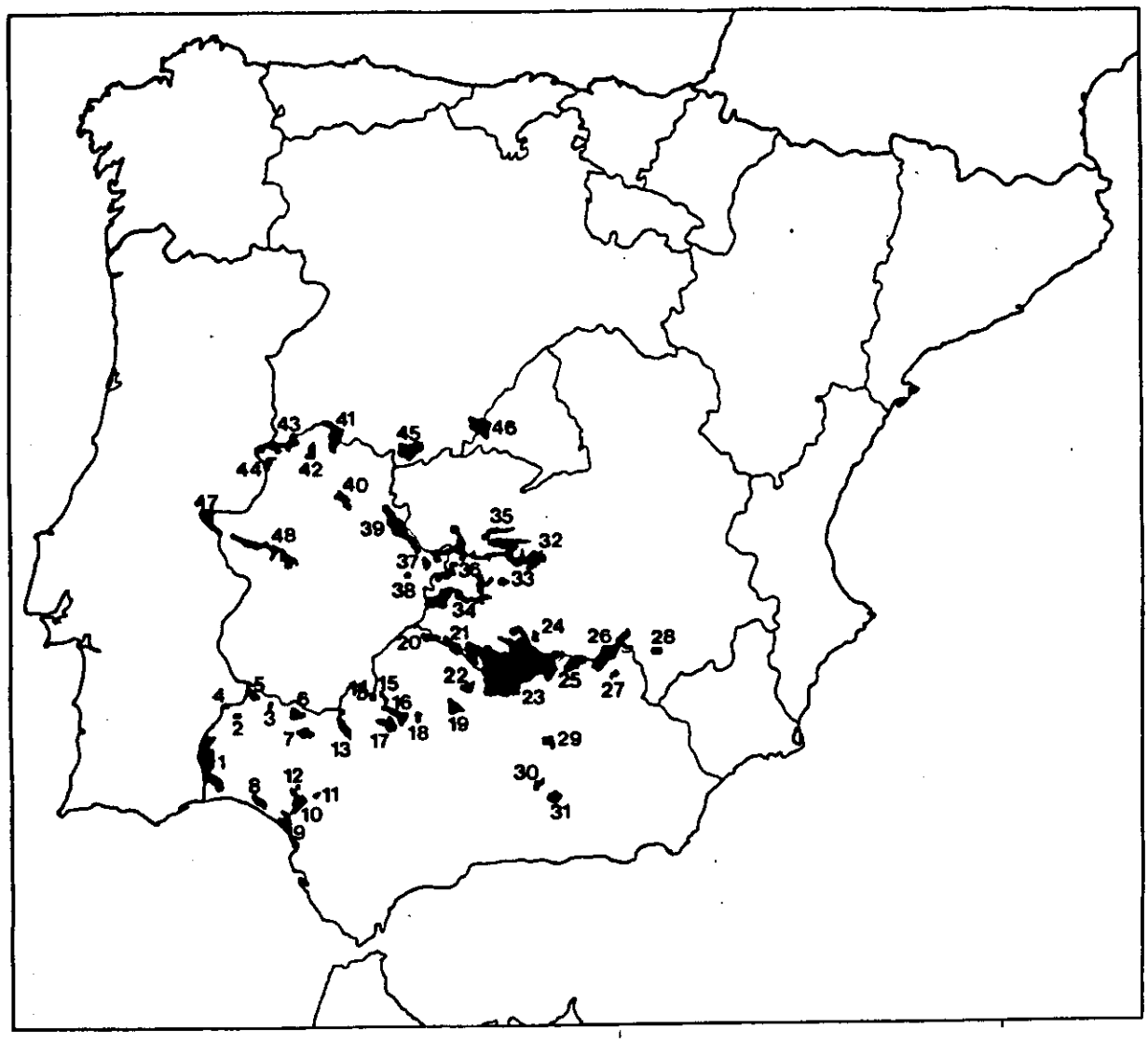
Reg. Pr. = extent of areas of regular presence, (in hectares).

Reg. + Occ. pr. = extent of areas, where the lynx's presence has been discerned, regularly or only occasionally, from 1988 onwards (in hectares).

Density = relative mean density, expressed as a fraction of the control density (0.16 lynx per km^2).

N = estimated size of population.

SM = Sierra Morena.



Map 2.A (source: Rodríguez and Delibes, 1988)

Present range of Lynx pardina in Spain, according to data obtained since 1978.

* a process of population fragmentation along an east-west line has been observed alongside mountain ranges; another move of lesser intensity occurs in a north-south direction.

Since 1960, this regression has occurred in two quite separate stages. In the first stage, from 1960 to 1980, widespread habitat destruction (forests planted with fast-growing trees, clearing and cropping of forest areas, public works etc) and a loss of nutritional resources due to the general thinning of the rabbit populations by myxomatosis, were the direct causes of this sizeable decline.

Gradual changes in regional planning policy over the past ten or so years have halted the process of habitat modification to some extent, thus apparently stabilising the lynx's range. However, this phenomenon has not been accompanied by a recovery in numerical terms: on the contrary, population densities have continued to decline as a result of a range of negative factors: loss of nutritional resources, isolation and fragmentation of populations, increased mortality due to human intervention etc.

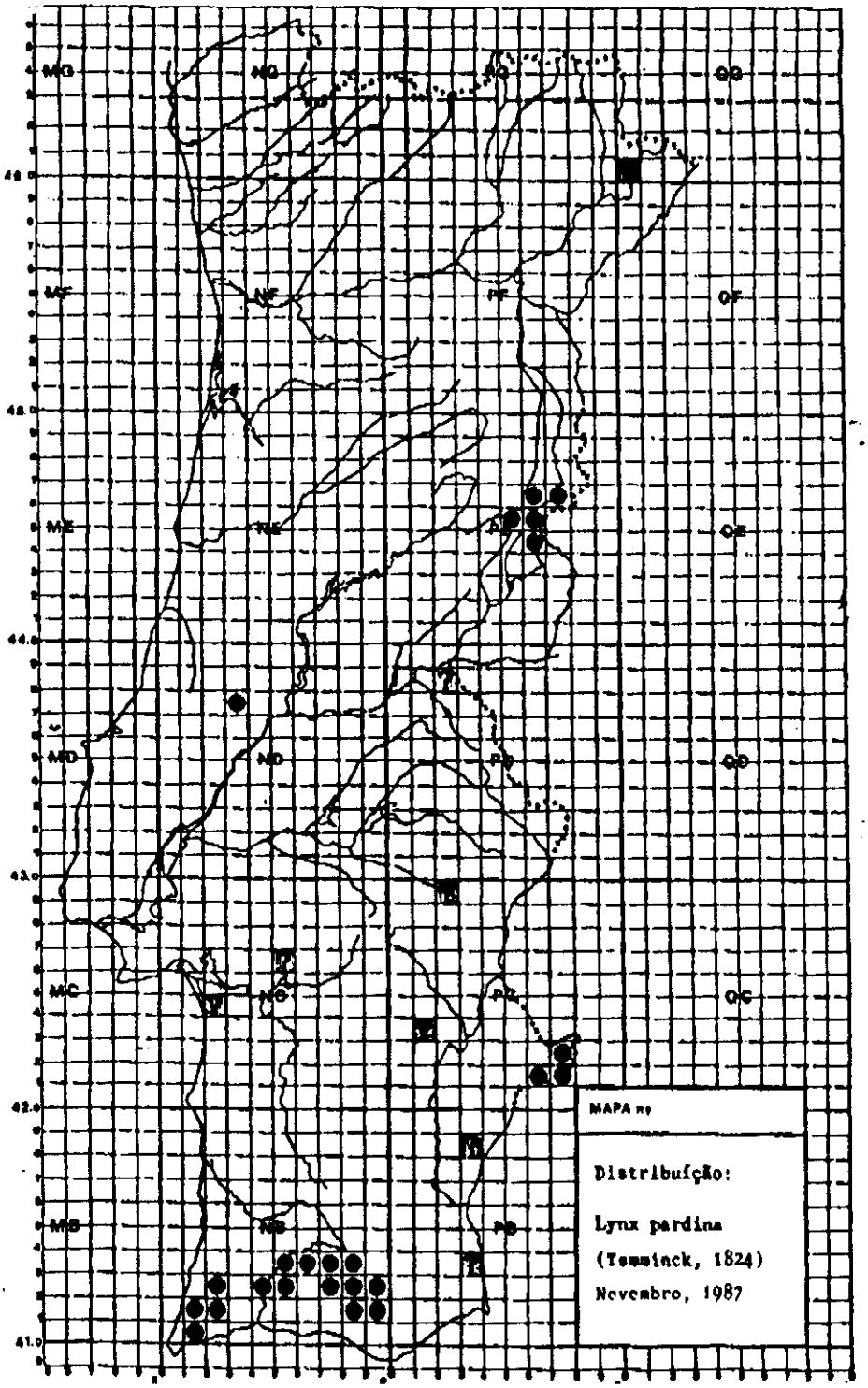
In Portugal, this process of regression, although less well documented, seems to be taking a similar course. Massive clearing operations, carried out as part of the "wheat programme", led to the disappearance in the 1940s of large areas covered with Mediterranean vegetation and inhabited by lynxes; some years later, with the appearance of myxomatosis and the planting of huge areas with rapid growth tree species (Pinus and Eucalyptus), there occurred a drastic reduction of potential lynx habitats and a significant fragmentation of its last population nuclei.

5. SIZE OF POPULATION

Extensive research carried out in earlier years in and around the Doñana National Park has made it possible to establish a relationship between the number of lynxes present in a region and the number of signs discovered in a given research programme using this information and taking the density obtained at Doñana (0.16 lynx per km^2) as the control density (value 1), Rodríguez and Delibes (1988) divided the range of distribution of the species according to density (table 2).

The table gives the results of this analysis and the size of the various stable population nuclei of lynx. According to these data, there were between 1,000 and 1,200 individuals in Spain in 1988, half of them adults.

In Portugal, although no field investigations have been carried out and no exact figure can be given, the lynx population is estimated at between 40 and 60 individuals.



Map 2.B

Distribution of lynx in 1987 in Portugal, source: data supplied by the Nature Parks, Reserves and Conservation Service.

6. THREATS TO THE SURVIVAL OF THE LYNX

6.1 Fragmentation of the range of distribution

As stated earlier, there are stable lynx populations in 48 areas in Spain and three areas in Portugal. However, at least 40 of these areas would appear to harbour no more than 25 individuals.

The probability of the disappearance of lynx from a particular zone is inversely proportional to the population size. That these small population nuclei are vulnerable is borne out by the data of Rodrígues and Delibes (1988), who demonstrate that by now the lynx has disappeared from 91% of the regions of less than 1,000 km2 which harboured it in 1960.

The problems of the small populations become more acute as other negative factors appear on the scene. Numerous studies conducted on other species of lynx (for example, Lynx rufus: critical review by Anderson, 1987) have shown that territorial requirements and density vary considerably depending on the resources offered by the habitat. Habitat quality in many of the present small nuclei is below the optimum, and lynx populations are sparse there. The risk of extinction, which in such conditions is high at the best of times, increases still further if the population is isolated.

According to data available on changes in the range of distribution, the process of deterioration among the small populations is so rapid (due to human intervention, lack of food, etc) that extinction is likely to occur even before the adverse processes caused by loss of genetic diversity.

6.2 Reduction of rabbit populations

As we have seen, rabbits are the basic food source for the pardel lynx; Rodríguez and Delibes (1988) have demonstrated that the density of lynx in a given region is closely linked to that of the rabbit population.

However, the lynx also occurs, albeit less densely, in a number of areas where rabbits are scarce. The decline of rabbit populations in many of these areas is of comparatively recent origin. When myxomatosis appeared in Spain in the early 1950s, the speed of its spread and the number of deaths it caused varied considerably from one area to another. The decimation of rabbits by myxomatosis, as well as by major habitat alterations in some cases, was rapid in many regions; some years afterwards, the lynx ceased to be established there.

Where the decline of the rabbit population was slower, the disappearance of the lynx was more gradual; although it survived in small densities, the impact of a single additional adverse factor could bring about its total disappearance; this happened, for example, in the Sierra de Aracena (Huelva), and also in the western half of the Toledo Mountains.

The decline of the rabbit populations is generally put down to myxomatosis; but other ill-identified factors seem to have an adverse effect, not least, no doubt, changes in land use. In Spain, the concern to make big game hunting profitable has left many Sierras untouched by clearing and afforestation schemes; the vegetation is well preserved, population pressure is only slight and much of the small game is undisturbed. Despite this rabbit populations continue to decline. The explanation may be that tracts of land formerly intended for grazing goats or growing crops on small plots have been abandoned and gradually invaded by thicket, with the result that rabbits can no longer prosper there as before.

This no doubt explains why evidence of the lynx's occurrence tends to be confined to the foothills, especially if the valley bottoms are used for pasture or cereal crops.

We could consider varying the eating habits of the lynx in order to make up for the shortage of its principal prey. It is known that the lynx breaks into henhouses in certain regions, and that it is well able to kill ungulates (deer and stags at Doñana; mouflons at Sierra Morena) (Beltrán and others, 1985), although we do not know to what extent prey of this kind, which is very abundant in some of the regions where rabbits are scarce, can constitute the basis of its food intake.

There is a further factor which has an adverse effect on rabbit populations: this is the epidemic of viral haemorrhagic pneumonia which, since reaching Spain in 1988, has been responsible for a high death rate among Lagomorpha.

However, it is not possible with the data available now to make any long-term predictions as to the impact of the epidemic.

Briefly, in the course of the past 30 years, lynxes have ceased to be present in abundance in the Sierras and now exhibit this maximum densities on the periphery close to wide open areas with large rabbit populations (Rodríguez and Delibes, 1988).

6.3 Mortality due to human intervention

Unlike the European lynx, the pardel lynx seldom attacks farm animals and has never been persecuted for that reason. However the lynx used to be slaughtered in Spain as a traditional game species, or as a predator of species of cynegetic interest.

During the 1950s, its capture was rewarded by the government through the intermediary of the "Juntas de Extinción de Alimañas" (Vermin Destruction Units). Hunting of the pardel lynx was banned in 1966, and it was declared a protected species in 1973.

Despite this legal protection, the lynx is often a victim of human action in Spain. Rodríguez and Delibes (1988) have compiled a new breakdown of the data concerning 1,215 lynx killed in Spain over the past 30 years (table 3).

The principal cause of mortality in the three periods under review is the gin trap. It is certain that many more lynxes die in traps set for rabbits than in "vermin" traps, although the table does not distinguish between the two.

The proportion of deaths caused by traps has declined over the past ten years, probably because the industrial exploitation of rabbits has diminished.

Firearms are the next most important means of capture. The proportion of lynxes killed by shooting has not varied appreciably in the three periods considered despite a steep increase in hunting; one consequence of this increase, however, is that more deaths are now caused by dogs during big game battues. Other causes, including road accidents, which were comparatively unimportant in 1978, now account for 7% of the annual total of deaths. This percentage will certainly increase when the road building programmes scheduled for the 1990s are completed.

In Portugal, the principal causes of mortality seem to be road accidents, traps and firearms.

6.4 Habitat loss and transformation

The main reason for the regression of the lynx in the Iberian Peninsula is without any doubt the loss of its natural habitat. Intensive forestry has caused large areas of natural vegetation to be replaced by pine and eucalyptus monocultures, making it impossible for the lynx to survive. Other factors, such as public building works or land clearing operations seem to have had less impact, although in some cases they have caused lynx populations to be broken up and isolated.

The scale of habitat loss and transformation would seem to be less now than in the past. The major investments scheduled for the coming years in the Regional Development Plan - 8.9 billion pesetas intended mainly for communications infrastructure building - will no doubt add to the adverse effects of habitat loss.

7. PROPOSALS FOR CONSERVATION

In Spain, the Act on the Conservation of Natural Sites and Wild Flora and Fauna requires the Autonomous Communities - which at present have full powers in the management of the environment - to devise "recovery plans" for species listed as being "endangered" (Decree 439/1990). The pardel lynx is among these. The National Nature Conservation Commission will be the body responsible for drawing up joint criteria to ensure that the recovery plans are implemented uniformly throughout the range of distribution of the lynx.

The long-term aim of the recovery plan is to enable the lynx to occupy as large a range as possible on a permanent basis. For this it is necessary, firstly, to halt its regression and, secondly, to increase population densities and create the conditions for natural recolonisation of areas lost in the past.

The measures set out below must be applied first in the regions at present containing the most sizeable population nuclei (eastern Sierra Morena, the Toledo Mountains, the corridors between these two zones, and certain regions of Extremadura); subsequently (phase two) in the remainder of the range of distribution; and (phase three) in unoccupied areas which could one day be included in the range.

	Sho	G.Tr	Sna	Tra	Dog	Rd	Ind.	Ot	% total	N
1958	21.18	65.88	0.60	0.50	3.53	-	8.23	-	46.45	170
1958 -1977	25.98	56.02	4.21	2.47	2.61	0.14	8.27	0.30	65.56	689
1978 -1988	26.12	32.30	6.18	5.90	6.74	7.02	12.92	2.81	22.49	356
TOTAL	25.35	50.45	4.28	3.21	3.95	2.14	9.63	1.00	40.50	1215

Table 3

Comparative importance (%) of different causes of mortality among lynxes in Spain. Source: Rodríguez and Delibes (1988).

Sho = firearms
G.Tr = gin-traps
Sna = snares
Tra = traps in general
Dog = dogs
Rd = road accidents
Ind. = causes unknown
Ot = other causes
N = number of deaths on record

The following measures are considered indispensable:

1- Increasing public knowledge of the practical problems of the lynx in the areas it occupies at present

To achieve this objective, it will be necessary to make a detailed review of the following aspects:

- land ownership, ie whether public or private: research has so far revealed that most estates inhabited by the lynx are privately owned;

- land use, especially from the standpoint of present-day economic viability: the available data prove that most land is used for hunting and livestock breeding;

- roads and other infrastructures;

- the composition and general appearance of the vegetation;

- the presence of rabbits.

Once the practical problems of the lynx in the areas it occupies are known, it will be possible to devise remedial strategies.

2- Preventing regression of the species

The following measures are considered indispensable:

2.1 Habitat protection. An impact study should be conducted before starting any major public or private investment project in areas occupied by the lynx.

2.2 Elimination of non-natural causes of mortality. As we have seen, removing the risk of death by trapping would eliminate a high proportion of non-natural mortality. This would mean:

- banning the use of gin-traps or snares in the commercial exploitation of rabbits. Where rabbit farming is an important livelihood, preference should be given to alternative methods (eg netting) that do not increase the rate of mortality among lynxes.

- refusing permission to use gin-traps or snares to capture predators. In regions where social pressures are still strong, other measures should be used in controlling fox populations (shooting, or unearthing the dens);

- reminding hunters of the total ban on shooting lynxes during battues and of the heavy fines imposed on offenders.

If these measures are to be applied, it is absolutely essential that the public authority should have the means of keeping a close watch on private hunting; at least one State-employed gamekeeper would be needed for every 10,000 hectares of territory.

3- Increasing the density of rabbit populations throughout the range of the lynx

The following measures should be considered:

- building up new rabbit populations in places where they have disappeared or diminished, and taking measures to ensure their successful survival (for example by protecting warrens against excavation by predators;

- pressing the public authorities to purchase private hunting rights in so far as their resources allow, in order to organise the rational exploitation of game and so improve rabbit population densities;

- transforming the vegetation cover (where conditions allow this) in order to increase rabbit populations. Management practice should include the clearing of zones of dense scrub and the plantation of crops on plots accessible to rabbits. Allowance must be made for the fact that the lynx needs very dense scrub for use as a refuge and open areas for hunting.

4- Encouraging research on the situation of the lynx

Full information on the situation and problems of the lynx must be obtained before management plans can be prepared and applied. The following research is necessary in order to supplement the information already available:

- a telemetric study of the lynx in western Sierra Morena, to obtain the necessary data on density, territorial requirements, juvenile dispersal, mortality and the impact of major public works;

- research into the reasons for the reduction of rabbit populations, especially in the south-western quarter of the Iberian Peninsula, and of the most appropriate methods for restocking and vegetation management.

5- Environmental awareness

Campaigns to increase environmental awareness, like those conducted in the neighbourhood of Doñana, should be extended to cover the whole of the present range of the lynx.

6- Other measures

- centralising the information at present available on the pardel lynx and that which will be obtainable when the recovery plans are implemented;

- preparing an enclosure for the care of wounded or sick lynxes;

- exploring the possibility of starting a reproduction programme for lynxes in captivity.

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9. REFERENCES

ANDERSON, E.M. (1987). A critical review and annotated bibliography of the literature on the bobcat. Special report n. 62. Colorado Division of Wildlife. Fort Collins.

ATANASOV, N. (1968). Der luchs (Lynx lynx L.) in Bulgarien. Acta Sc. Nat. Brno, 2 (4): 25-32.

BELTRAN, J.F. (1987). Base bibliográfica de especies amenazadas. Lince ibérico (Lynx pardina Temminck, 1824). Junta de Andalucia. Agencia de Medio Ambiente, Sevilla.

BELTRAN, J.F., SAN JOSE, C., DELIBES, M. et BRAZA, F. (1985). An analysis of the Iberian lynx predation upon fallow deer in the coto Doñana, SW Spain. Trans. XXVII Congr. IUGB: 961-967. Min. Agric. Brussels.

BELTRAN, J.F., ALDAMA, J. et DELIBES, M. (1987). Ecology of the Iberian Lynx in Doñana, SW Spain. XVIII Congr. IUGB, Krakow, agosto de 1987.

BRINK, F.H. van den (1970). Distribution and speciation of some carnivores. Mammal Rev., 1 (3): 67-68.

BRINK, F.H. van den (1971). Le lynx pardelle en France. Bull. Soc. Etudes Sc. Nat. Nîmes, 51: 95-109.

CABRERA, A. (1914). Fauna ibérica. Mamíferos. Museo Nacional de Ciencias Naturales. Madrid.

CORBET, G.B. (1978). The mammals of the Palearctic Region: A taxonomic review. Brit. Mus. Nat. Hist. & Cornell Univ. Press. London.

DELIBES, M. (1979). Le lynx dans la Péninsule ibérique: répartition et régression. Bull. Mens. Off. Nat. Chasse, n. sp. Sci. Tech., Le lynx: 41-46.

DELIBES, M., PALACIOS, F., GARZON, J. et CASTROVIEJO, J. (1975). Notes sur l'alimentation et la biologie du lynx pardelle, Lynx pardina (Temminck, 1824), en Espagne. Mammalia, 39 (3): 387-393.

GARZON, J. (1978). Die situation des Luchses in Spanien. En "Der Luchs in Europa". A. Festetics (ed.): 161-169. Kilda-Verlag. Greven.

GRAELLS, M.P. (1897). Fauna mastodológica ibérica. Mem. Real Acad. Ciencias, XVII: 224-229. Madrid.

HONACKI, J.H., KINMAN, K.E. et KOEPPL, J.W. (1982): Lynx pardina en "Mammals species of the world. A taxonomic and geographic reference". Allen Press and the Association of Systematic Collections. Kansas.

KURTEN, B. (1968). Family Felidae, Cats. En "Pleistocene mammals of Europe": 72-90. Weidenfeld & Nicholson. London.

MALLISON, J. (1978). Lynxes. European lynx (Lynx lynx) and pardel lynx (Lynx pardina). En "The shadow of extinction": 141-148. Macmillan. London.

PALMA, L.A. (1980). Sobre distribuçao, ecologia e conservaçao do lince iberico em Portugal. Act. I Reunión Iberoamer. Zool. Vert.: 569-586. La Rábida (Huelva). 1977. Ministerio de Universidades e Investigación. Sevilla.

Rodríguez, A. et DELIBES, M. (1988). El lince ibérico en España. Document non publié. ICONA. Madrid.

VALVERDE, J.A. (1963). Información del lince en España. Bol. Técnico, Serie cinegética, 1. SNPFC, Ministerio de Agricultura. Madrid.

VASILIU, G.D. et DECEI, P. (1964). Uber den Luchs (Lynx lynx) der Rumanischen Karpaten. Säugetiek. Mitt., 12 (4): 155-183.

WERDELIN, L. (1981). The evolution of lynxes. Ann. Zool. Fennici, 18: 33-71.

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